SCHOOL OF CIVIL ENGINEERING

INDIANA DEPARTMENT OF TRANSPORTATION
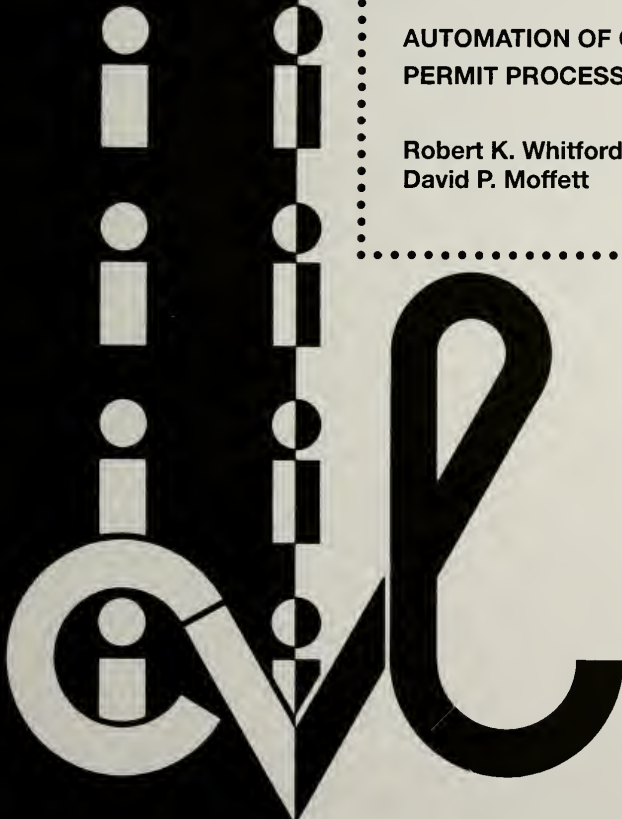
AUTOMATION OF OVERWEIGHT TRUCKS PERMIT PROCESS FOR MICHIGAN TRAINS

Robert K. Whitford
David P. Moffett

PURDUE UNIVERSITY

AUTOMATION OF OVERWEIGHT TRUCK PERMIT PROCESS
FOR
MICHIGAN TRAINS

by

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16. Abstract

Technical guidance was provided by Purdue University to the Indiana Department of Transportation regarding specific issues around the automation of permit issuance for overweight and oversized vehicles on a specific piece of highway in Northwest Indiana. Supporting this guidance were four commentaries which were:

1.   Functional Specification for Automation of Michigan Trains
2.   Draft Commentary on Touch Tone™/Voice Response System Security for Michigan Trains
3.   Draft Commentary on Touch Tone™/Voice Response System Vendor for Michigan Trains
4.   Draft Commentary on Touch Tone™/Voice Response System Auditability for Michigan Trains

These are included as appendices to this report.

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CHAPTER 1

Project Overview

Following the study on Permit Procedures for Overweight Trucks,[1] a quick study to determine how the Michigan Trains permitting process should be automated was conducted. The quick study, which mainly was used to glue [1] to an implementation utilizing the knowledge already gained, was requested by INDOT in July of 1995. During the execution of this study, it was determined that the Indiana Governor had ordered the creation of a "one-stop shop" to service all truck permitting & licensing needs. This "one-stop shop" ultimately would need to reside within the Indiana Department of Revenue (IDR) instead of the Indiana Department of Transportation as they already had the majority of the other permitting and licensing functions. The Purdue team thus worked with INDOT, the Department of Revenue and finally the state's central services to develop a Michigan Train permitting solution.

Because of their expertise in the overweight truck permit process and in-depth computer knowledge, Purdue was asked to provide services by assigning Mr. David Moffett and Dr. Robert Whitford. The work plan they undertook was:

1.   To evaluate alternative implementation schema, considering the various systems available on the market, especially those being used in the banking industry, and develop an understanding of the potential for the present Indiana Department of Revenue Computer to accommodate the added equipment and software required to effect the Michigan Train automatic permit process.

2.   To recommend from these alternatives a single approach for implementation.

3.   To generate a functional/operating specification for the system. This specification is presented in Appendix B. The related flow chart is shown as

---

1. Moffett, David P. and Whitford, Robert K., Development of Annual Permit Procedure for Overweight Trucks on Indiana Highways, FHWA/IN/JHRP-95/5 Final Report, December 31, 1995.

FIGURE 1   Flow chart reflecting the sequence of steps in automated touch-tone
            system for obtaining a permit for Michigan train.

WELCOME

Enter Automation Permit (Access) Number Truck and Company Unique Numbers → More Info about System

Enter PIN

no → Verify → yes

Thank You

This section would be replaced with a very complex system if permit requestors do not have truck number, company number, license number, etc. on file with the state of Indiana. Much of this data is alpha-numeric and the ambiguity that exists when pressing "3" on the keypad beign "D," "E," or "F" must be resolved through a series of additional data entry steps

Enter date of Permit

no → Verify → yes

Enter Commodity Carried

no → Verify → yes

Enter Origin

no → Verify → yes

Enter Destination

no → Verify → yes

Your Account has been charged

Your Permit Number is xxxx

Do you want your Permit Number Repeated ? → yes

no

Do you want another permit?
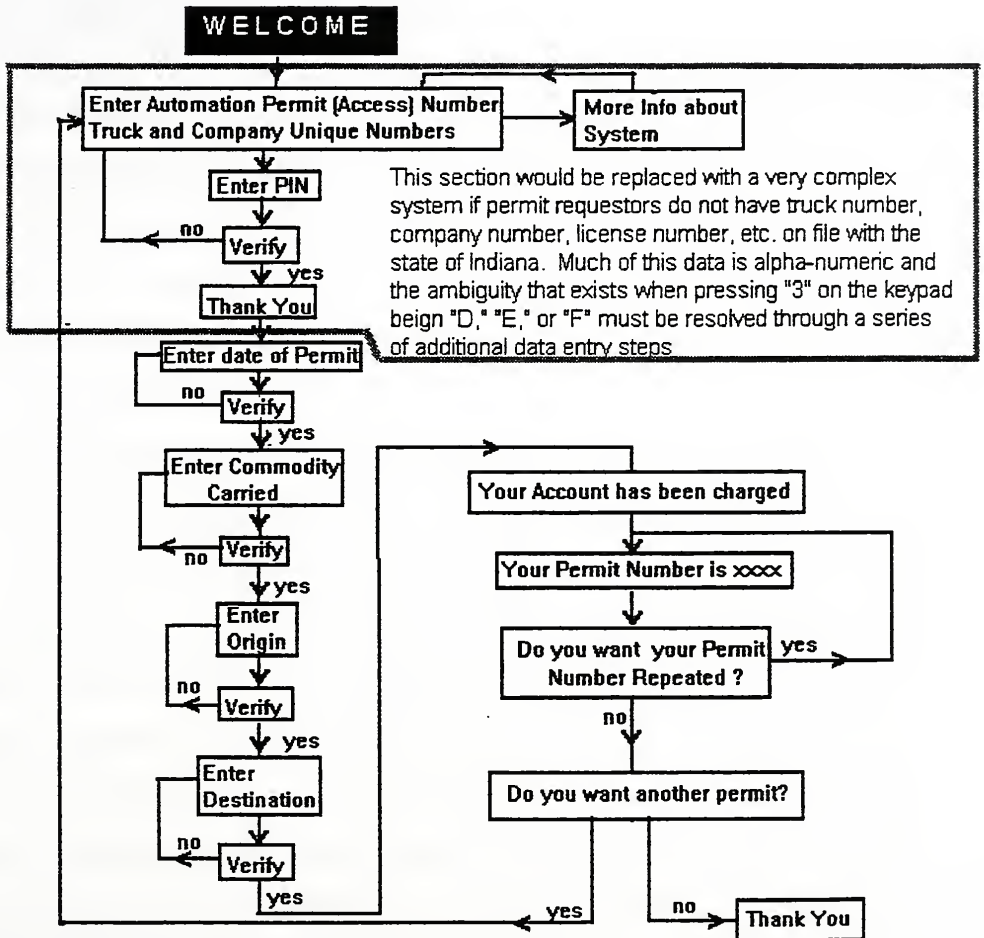
yes   no → Thank You

Figure 1. It shows the process of query, answers and verification as the caller moves through a typical process of obtaining a permit.

4.   To support INDOT/Indiana Department of Revenue implementation.

5.   Write a summary report (this document).

A specification was generated in about six weeks after numerous contacts with both INDOT and Department of Revenue persons directly connected with the activity.

Because of the nature of the study all reports were in draft form and delivered to Mr. Zandi for his use in the INDOT portion of responsibility in oversight of the shift of the permitting clerk and revenue function to the Department of Revenue .

Three basic concerns were the subject of further drafts papers, namely: security, vendor choice and maintaining "audit-ability" for future billing and information retrieval (audit trails are needed for potential future legal action). These appear as Appendices C, D, and E, respectively.

The work by Purdue determined the version of the Touch Tone/Voice Response system that is best suited to the Michigan Train Permits will work well on the Indiana Department of Revenue Computer. Hardware and software needs are straightforward and can be easily met by a relatively inexpensive and straightforward expansion of the existing Taxpayer Information System (which utilizes IBM's Direct-Talk II system) that IDR already has extensive experience in using. Expertise in the form of an experienced vendor who set up much of the original taxpayer information system was available to work on this. This expertise, in particular, dealt especially with the pre-existing layers of security that IDR uses.

CHAPTER 2

Implementation Plan

Because of the nature of this work the only implementation plan that is appropriate is that the permit system be upgraded to complete many of the routine permits for Overweight/Oversize trucks. That will require more data that will be entered by the telephone keyboard, but the technical capability and the approach is basically the same as for the simpler Michigan Trains permit data requirements.

Appendix A

Proposal
for
Quick Study on Automation of Michigan Trains Permitting

Proposal

for

Quick Study on Automation of Michigan Trains Permitting

by

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and

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Professor of Civil Engineering

Joint Highway Research Project
Project Number: C-36-73.O
File Number: 3-4-15

Civil Engineering Building
Purdue University
West Lafayette, Indiana

July 21, 1995

Proposal

for

Quick Study on Automation of Michigan Train Permits ?

by

Dave E. ...
Graduate Research Assistant

and

Kumares ... Rao
Professor of Civil Engineering

Civil Engineering Building,
Purdue University
West Lafayette, Indiana

July 21, 1995

This memo contains what we believe will accomplish the most good within the INDOT and the State as far as the automation of permitting for Michigan Trains. The memo is broken up into sections. The first contains a small background about the principal staff (David Moffett). Secondly is commentary about computing environments. The third is a statement of the goal of this project. Finally, there are a few approaches for meeting this goal.

Personnel Background

David Moffett has been in the computer industry for over 22 years. He knows around twenty computer languages and has designed sophisticated hardware & software for computer process control. Additionally, he has taught Software Engineering, Object-Oriented Programming and software design theory to both graduate and undergraduate Computer Science students. He is currently an automation and technology consultant to several businesses. He hold a B.S. and an M.S. in Civil Engineering and is nearing completion of a Ph.D.

His background is important because the commentary that follows depends not only on the technology but also on the political and technical arena in which any proposed solution will operate. The computer industry's history is full of technologically wonderful projects that, in the end, flop because either the technical level of those who operate and support the project are out of sync with the project or the politics cause the system to never gain acceptance. In the State's case, there has been a shortage of new technology oriented people with in INDOT. These facts weigh heavily on the path selected for Michigan Trains automation as well as automation for permitting in general.

Computing Environments

When an Information Systems (IS) department decides on hardware, or on a particular operating system that they will use, then the whole philosophy of how things are to be done is decided at the same time. The State of Indiana is, and for quite a while has been, an I.B.M. shop. By selecting I.B.M., decisions about which operating system to use were considerably narrowed as well as the software development philosophy that will be followed.

The State's information infrastructure is centered around IBM hardware, an operating system that has its roots in the 1970s and a strong COBOL programming environment. Systems that are able to interact with users were considered by I.B.M. mostly after both the core hardware and operating system designs were complete. As a result, interactive programming is restricted considerably. Clearly, a programmer would much rather write interactive programs for a PC or for one of many newer operating systems. The I.B.M. mainframe environment excels at doing batches of things and to a lesser degree deals with on-going user interactions.

Also, when the I.B.M. decision was made, there was an implicit decision to hire a certain kind of programming and systems staff. These people are usually old-timers who have had many years of I.B.M. experience. They are often very highly trained for the complexities that occur when using I.B.M. systems. On the other hand, they are mostly

far from the leading edge of computing, and unless special pains are taken, often find themselves technologically obsolete before their career's are over.

This background is important because a Touch-Tone™/Voice Response system is much closer to the leading edge than much of what is typically done at an I.B.M. shop. Finding sufficient staff to program, debug, and support such a system in house will probably be a problem.

How companies typically deal with the introduction of new technological specialties is in one of several ways. Often, companies hire new talent who can adequately support new technology. At the moment, companies like Federal Express in Memphis, TN are hiring large numbers of Unix™ technical staff because they lack a Unix knowledge base. Sometimes, new technology is brought in as a black box by the company buying the technology as a package. Indiana National Bank (now NBD), when they started doing bank-by-phone, purchased a very expensive package written by one of very few specialty companies. Subsequently, the in house staff just called the specialty company to handle the problems as they came arose. Infrequently, staff that already is employed by the company is sent out for more education so that they can work with the new technology. In aid of helping old staff with newer technologies, all sorts of software and hardware vendors offer intermediate products or building blocks that hide the new technology in old technology wrappers.

We are very concerned that whatever TT/VR system is implemented will be sufficiently well supported both in the short and long term. It will need to be a "good fit" within the rest of the State's information infrastructure.

The Goal

An easily implemented, timely, cost effective, supportable system to automate routine requests for Michigan Train permits using Touch Tone/Voice Response technology.

Ways of Accomplishing Our Task

With the preceding said, there are several paths that can be taken. In the coming weeks we will attempt to understand all that will be required to follow one or another of these paths:

1. Home Grown -- High Technology
2. Home Grown -- Lower Technology
3. Purchased Systems -- I.B.M. based
4. Purchased Systems -- I.B.M. interfaced

By "Home Grown" we mean systems that take basic building blocks of hardware and software and build a TT/VR system from the ground up. Home Grown systems can either be written by in-house programmers or contracted out with a specification prepared in house. "Purchased Systems" are like those acquired by banks for bank-by-phone or many other externally designed and written systems. Some very popular purchased systems are core accounting and payroll. Accounting, because it is very standard and payroll because the same changes are needed by many different companies. In either case, the cost of doing the programming is distributed across many customers and is a cost savings to everyone.

Home Grown systems are much more flexible but always will need more support from internal resources. Purchased systems are usually available more quickly, are substantially less flexible and require recurring external expenditures to maintain the license and support from the vendor.

Some details and comments about each of the possible paths seem appropriate here.

1. Home Grown -- High Technology

If we were on our own, we would suggest this alternative. We would ignore the support, political, and technological problems. As a result, it would probably fail since it is probably a poor fit within the State's information infrastructure!

Very simply, this path has a TT/VR system pretending to be an operator at a normal terminal. Few changes would be required to add this to the existing system.

Figure 1
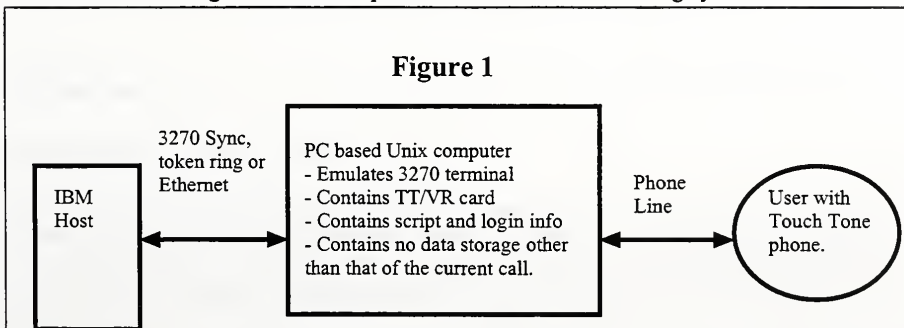
We became excited by this alternative because it can be done cheaply, using off-the-shelf hardware, and with a small software development effort. The disadvantage is that there is little Unix experience inside the state and so software development will be a problem.

2. Home Grown -- Lower Technology

IBM sells TT/VR hardware that interfaces with existing IBM hardware. While we have no experience with it, nor have we had a recent look at the pricing for it, we know a few years ago it was quite expensive, especially when compared to the costs in Alternative #1. However, their hardware will fit as well as any with the IBM way of doing things. Our information on this equipment is old, and we will update it. We think that it interfaces to the host approximately like Figure 2.

FIGURE 2
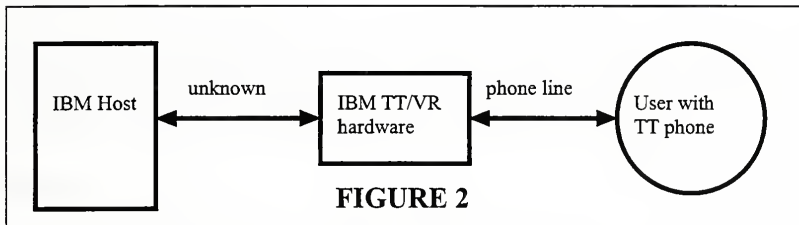
The major problem with such an implementation is that then there needs to be a substantial programming effort on the IBM computer in order to have the TT/VR hardware function.
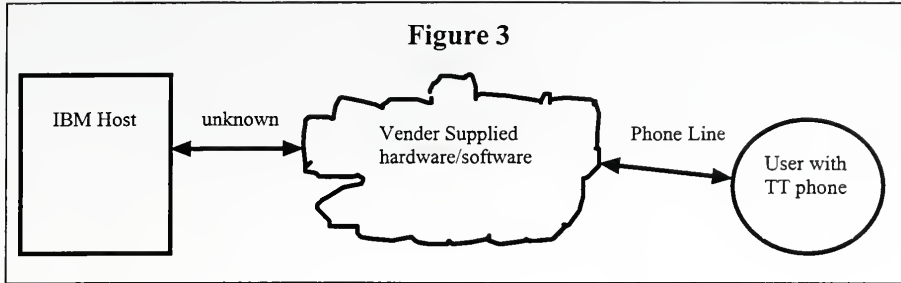
3. Purchased Systems -- I.B.M. based

A purchased system, that is IBM based, will look much like Figure 2. We are not particularly optimistic about the possibility of this path for two reasons. First, we think that the Michigan Trains permitting problem is a sufficiently odd application that, at best, we could suggest buying purchased modules that would have to then be glued together by state programmers or by a contractor working closely with State IS staff. Second, we are only aware of firms selling complete products for IBM hardware. Thus, even finding someone who is willing to sell modules is a problem in its own right.

This option is separate from #4 because the great majority of the computing is done on the IBM host.

4. Purchased Systems -- I.B.M. interfaced

Much like our alternative #1, we would not be surprised to find various vendor's products working on stand-alone computers connected to the IBM host. Here again, we are not familiar with current vendors, but expect that the oddness of the application will not lend itself to a pre-packaged complete solution. These, if they can be found, will look like figure 3.

Figure 3

IBM Host — unknown → Vender Supplied hardware/software — Phone Line → User with TT phone

Work Plan

Three tasks are anticipated that will be done in the few weeks:
1. Develop a system specification and several proposed implementation approaches
2. Work with INDOT to identify the interface problems with their present system.
3. Prepare a concise work plan to get Michigan Trains automated.

Budget

• Whitford - 10% - July 15 - October 15, 1995	$2000
• Moffett - 50% - July 15 - October 15, 1995	$3360
• Travel to Indy - 10 trips	$ 265
	$5625

Closing Remarks

In working with the state on permitting, we have found that lots of studies and reports have been written, and yet the problems still remain. We hope to report updates of our work on a timely basis. These updates, as a set, will constitute our final report, since we hope that our real final report is a concise work plan to get Michigan Train permitting automated.

The State already has at least one Touch-Tone/Voice Response system installed and working. It is part of the Indiana Department of Revenue and allows taxpayers to check on the disposition of their tax refund [the number is (317) 233-4018]. We will explore how this was implemented and hope that the IDR solution methodology is one that can be easily transferred to that of Michigan Trains.

Finally, projects like this one are not done in a vacuum. If you have questions or comments please feel free to contact us.

Appendix B

**Draft Functional Specification for Automation of
Michigan Trains**

Quick Study on Michigan Train Permitting

Draft Functional Specification for Automation of Michigan Trains

Robert K. Whitford
David P. Moffett
Purdue University, School of Civil Engineering

ABSTRACT

This is a DRAFT functional specification for the automation of the permitting process for a subset of overweight vehicles using the "extra heavy duty highway" in northern Indiana. These vehicles are often known as "Michigan Trains". The automation is by means of a computer controlled voice interacting with a user who is entering information by DTMF telephone.

This specification covers the user interaction and supplemental logging of such transactions. It presents three alternatives that the state should consider before implementation begins. It does not cover the necessary changes to be made to the existing system, though those changes can be easily implied. Some notes about each alternative follow.

1. System Configuration

2. Notation

Items in square brackets are characters a user keys in by their telephone dial. [9] means they pressed the number 9.

Items in italics are spoken by the voice response system. *Welcome* is an example.

Items in curly braces { } are reference points for notes. They are not part of the script. Note numbers are not reused from one alternative to another and frequently refer to another alternative.

3. Alternatives

3.1. Alternative 1 - Optimal for User Use

3.1.1. Overview

This alternative eliminates as many keystrokes as possible to reduce the complexity to the user as well as shorten the call's duration. Reduced call durations yield a better level of service for all users.

This alternative introduces a new number as well as a PIN to the system. The system impact means that this number must be looked up to gain the truck, company and if applicable, the annual permit number. Then the system looks these numbers up without bothering the user.

3.1.2. Interaction

Here is a sample interaction

[8][0][0] [x][x][x] [x][x][x][x]

Welcome to the State of Indiana's automated permit granting system.

{1}
Enter your permit automation number followed by a star.
Enter zero star for more information on this system:

[0][*]

The State of Indiana's automated permit granting system
allows for fully automated granting of some kinds of over
weight truck permits. This system is usually available 24
hours a day, seven days a week. Before using this system,
users must have already been enrolled with the state.
Enrollment includes providing the state with various infor-
mation about your company, insurance, vehicle and method of
paying for the permits.

For operator assistance dial 800-xxx-xxxx. {3}

Enter your permit automation number followed by a star.
Enter zero star for more information on this system:

[1][2][3][4][5][6][*]

Enter the personal identification number followed by a star:

[1][2][4][3][*]

You have entered an incorrect permit number or PIN.   Please reenter the permit automation number followed by a star:

[1][2][[3][4][5][6][*]

Enter the personal identification number followed by a star:

[1][2][3][4][*]

Thank You

{9}
Enter the date on which the permit should be effective. {3}

Press the four digits of the year, two digits for the month, two digits for the day and then a star.

[1][1][9][5][1][2][1][2][*]

The date entered has already occurred. Please reenter the date:

Press the four digits of the year, two digits for the month, two digits for the day and then a star.

[1][9][9][5][2][1][2][*]

The date entered does not have enough digits. For days and months that are single digits, be sure to place a zero in front of them.

Press the four digits of the year, two digits for the month, two digits for the day and then a star.

[1][9][9][5][4][2][1][2][*]

The month entered is larger than twelve. Please reenter the date:

Press the four digits of the year, two digits for the month, two digits for the day and then a star.

[1][9][9][5][1][2][1][2][*]

Is December twelfth nineteen ninety-five correct? Press one

for yes, zero for no.

[2]

In incorrect response was entered.

Is December twelfth nineteen ninety five correct? Press one for yes, zero for no.

[1]

{11}

Enter the type of load this vehicle will be carrying. Press zero then star for a menu of possible load types:

[0][*]

The possible load types are each numbered. The number following each type is the number that should be entered.

corn - one
hot asphalt - two
steel plate - three
steel coil - four
 or
other - nine

Enter the type of load this vehicle will be carrying. Press zero then star for a menu of possible load types:

[4][*]

Is steel coil correct? Press one for yes, zero for no.

[1]

Enter the origin number followed by a star. Press zero then star for a menu of possible origins:

[0][*]

The possible origins are each numbered. The number follow-

ing each name is the number that should be entered. {4}

Burns Harbor - one
East Chicago - two
Furnaceville - three
Gary - four
Hammond - five
Michigan City - six
New Carlisle - seven
Portage - eight
Porter - nine
Rolling Prairie - ten
South Bend - eleven
Springville - twelve
Westfield - thirteen
or
Michigan State Line - fourteen

Enter your origin number followed by a star. Press zero then star for a menu of possible origins:

[1][*]

Is Burns Harbor correct? Press one for yes, zero for no.

[1]

Enter your destination number followed by a star. Press zero then star for a menu of possible destinations:

[0][*]

The possible destinations are each numbered. The number following each name is the number that should be entered.

Burns Harbor - one
East Chicago - two
Furnaceville - three
Gary - four
Hammond - five
Michigan City - six
New Carlisle - seven
Portage - eight
Porter - nine
Rolling Prairie - ten
South Bend - eleven

Springville - twelve
Westfield - thirteen
or
Michigan State Line - fourteen

Enter your destination number followed by a star. Press zero then star for a menu of possible destinations:

[1][4][*]

Is Michigan State Line correct? Press one for yes, zero for no.

[1]

Your account has been charged.

Your permit number is zero one two three four.

Press one to have the permit number repeated. Press zero to continue.

[1]

Your permit number is zero one two three four.

Press one to have the permit number repeated. Press zero to continue.

Press one to request another permit, zero to finish this call.

[0]
{7}

Thank You.

click.

3.1.3. Notes:

1. This is the return point for gaining multiple permits

2. This is the normal voice 800 number.

3. Date validation should cover month range, day range within the month, year, and then make some good guesses about incorrect order of entry. Dates before the current date are also unacceptable. Space should be left in the system for entering a time following the date as there is discussion about making the permits valid for 24 hours starting at whenever they're requested to start.

4. The origin and destination lists are from "Truck Talk about Michigan Trains" dated August 1, 1994. They are presented in alphabetical order.

5. Load types are those that Purdue discovered during the previous study. There may be others. They are presented in alphabetical order.

6. Three incorrect permit automation number/PIN number pairs should terminate the call and generate log messages to that affect.

7. If the user had requested another permit number, they should be returned back to {1}. A limit of ten permits per call seems very reasonable. The current utilization pattern, namely multiple permits per call, Purdue believes will end if this system is always available, reliable and very infrequently busy.

8. The order of questions is the same as those presented currently by the operator.

9. This is an entry point for some of the other alternatives.

10. Marker in Alternative 2

11. This is an entry point for another alternative.

3.2. Alternative 2 - PIN with little System & Programming Impact

3.2.1. Overview

This alternative requires more user knowledge about how they are permitted. In particular it needs to know how the truck is permitted (either annual or per-call) as well as truck and company number.

This alternative introduces a PIN to the system. See the commentary on PIN numbers.

One major complication that this method has is the letter that is the last character of the company number. The normal telephone keypad has letters, but they are not unique to a key (three letters per key usually). Thus is one is told to press "A", there are three letters that could be, namely "A", "B", and "C". Further, there is also confusion about the difference between the letter O and the number 0. Further, two letters are missing off the traditional DTMF keypad, namely Q and Z.

Another substantial complication is the single-trip permit's need for substantial alphanumeric entry.

3.2.2. Interaction

[8][0][0] [x][x][x] [x][x][x][x]

Welcome to the State of Indiana's automated permit granting system.

{1}
Enter your company number excluding the trailing letter. Enter zero star for more information on this system:

[0][*]

The State of Indiana's automated permit granting system allows for fully automated granting of some kinds of over weight truck permits. This system is usually available 24 hours a day, seven days a week. Before using this system, users must have already been enrolled with the state. Enrollment includes providing the state with various infor- mation about your company, insurance, vehicle and method of paying for the permits.

For operator assistance dial 800-xxx-xxxx. {3}

Enter your company number excluding the trailing letter. Enter zero star for more information on this system:

[1][2][[3][4][5][*]

Press the key that has the final number on it. For Q or Z press one.

[4]

Press the position on the key that the letter holds. For the first letter on the key press one, for the second letter on the key press two, for the third letter on the key press three. For Q press one, for Z press two.

[2]

Is 12345H the correct company number? Press one for yes,

zero for no.

[1]

{17}
Enter the personal identification number followed by a star:

[1][2][4][3][*]
{18}

Thank You

{9}
Enter the date on which the permit should be effective. {3}

*Press the four digits of the year, two digits for the month,
two digits for the day and then a star.*

[1][9][9][5][1][2][1][2][*]

*Is December twelfth nineteen ninety-five correct? Press one
for yes, zero for no.*

[1]

*Enter one if this is permitted on an Annual Permit or two if
it is a single trip permit.*

{10}
[1]

Enter the annual permit number followed by a star.

[1][2][3][4][5][*]

At this point, the remainder of the permit process is as it
was in alternative 1. Join that script at {11}.

--------------- Single Trip Permit Inset

{12}
[2]

Enter the last five digits of the truck serial number fol-

lowed by a star.

[9][9][9][9][9][*]

*Enter the number of the make of the truck followed by a
star. Press zero then star for a list of possible makes.*

[0][*]

*The possible trucks brands are each numbered. The number
following each name is the number that should be entered.*
{13}

Ford - one
General Motors - two
International Harvester - three
Mac Truck - four
Navstar International - five
Peterbilt - six
Saab - seven
Volvo - eight
White - nine
 or
Other - ninety-nine

*Enter the number of the make of the truck followed by a
star. Press zero then star for a list of possible makes*

[4][*]

Is Mac Truck correct? Press one for yes, zero for no.

[1]

{14}
*Enter the state or province that the tractor is licensed in
followed by a star. Press zero star for a list* {15}

[0][*]

*The possible states and provinces are each numbered. The
number following each local is the number that should be
entered.* {13}

In the United States: Alabama - one Alaska - two Arizona -

three Arkansas - four American Samoa - five California - six Colorado - seven Connecticut - eight Delaware - nine District of Columbia - ten Federated States of Micronesia - eleven Florida - twelve Georgia - thirteen Guam - fourteen Hawaii - fifteen Idaho - sixteen Illinois - seventeen Indiana - eighteen Iowa - nineteen Kansas - twenty Kentucky - twenty-one Louisiana - twenty-two Maine - twenty-three Marshall Islands - twenty-four Maryland - twenty-five Massachusetts - twenty-six Michigan - twenty-seven Minnesota - twenty-eight Mississippi - twenty-nine Missouri - thirty Montana - thirty-one Nebraska - thirty-two Nevada - thirty-five New Hampshire - thirty-six New Jersey - thirty-seven New Mexico - thirty-eight New York - thirty-nine North Carolina - forty North Dakota - forty-one Northern Mariana Islands - forty-two Ohio - forty-three Oklahoma - forty-four Oregon - forty-five Palau - forty-six Pennsylvania - forty-seven Puerto Rico - forty-eight Rhode Island - forty-nine South Carolina - fifty South Dakota - fifty-one Tennessee - fifty-two Texas - fifty-three Utah - fifty-four Vermont - fifty-five Virgina - fifty-six Virgin Islands - fifty-seven Washington - fifty-eight West Virgina - fifty-nine Wisconsin - sixty Wyoming - sixty-one in Canada
... in Mexico
...

Enter the state or province that the tractor is licensed in followed by a star. Press zero star for a list

[1][8][*]

{16} *Character by character the license plate number needs to be entered. Press a single star when entering is complete.*

Press 1 if the first character is a number, 2 if it is a letter or star to finish. {16}

[1]

Please enter the first digit

[1]

Press 1 if the second character is a number, 2 it is is a letter or star to finish.

[1]

Please enter the second digit

[8]

Press 1 if the third character is a number, 2 if it is a letter or star to finish.

[1]

Please enter the third digit

[6]

Press 1 if the fourth character is a number, 2 if it is a letter or star to finish.

[1]

Please enter the fourth digit

[8]

Press 1 if the fifth character is a number, 2 if it is a letter or star to finish.

[2]

Press the key that has the final number on it. For Q or Z press one.

[8]

Press the position on the key that the letter holds. For the first letter on the key press one, for the second letter on the key press two, for the third letter on the key press three. For Q press one, for Z press two.

[1]

Press 1 if the first character is a number, 2 if it is a letter or star to finish.

[*]

[1]

Please enter the second digit.

[8]

Press 1 if the third character is a number; 2 if it is a letter or sign to finish.

[1]

Please enter the third digit.

[8]

Press 1 if the fourth character is a number; 2 if it is a letter or sign to finish.

[1]

Please enter the fourth digit.

[8]

Press 1 if the fifth character is a number; 2 if it is a letter or sign to finish.

[9]

Press the key that has the letter on it... then press one.

[8]

Press the position on the key that your letter is; press one. For the first letter on the key press one, for the second letter on the key press two, for the third letter on the key press three. For Q press one, for Z press two.

[5]

Press 1 if the first character is a number; 2 if it is a letter or sign to finish.

[5]

Is 1868t correct? Press one for yes, zero for no.

[1]

At this point, the remainder of the permit process is as it
was in alternative 1. Join that script at {11}.

3.2.3. Notes:

10. At this point, there is a split in the interaction depending on the user's
response. If they reply '1', then continue following the script. If they reply '2', first
interaction is for annual permitted trucks. The second is for pay-by-trip vehicles at
marker {12}.

13. Further research will need to be made to assure this list is complete.

14. At this point things begin to get really pretty complicated. Both the state the
license plate is from and the actual plate data entry are painful, tedious and consuming
time into the TT/VR system.

15. One alternate way to do this instead of a menu is have the user spell out the state
on the keypad and then hope to look that up as a number to cross reference it to a state
name. Then, the state name would have to be confirmed as is done here.

16. The TT/VR vendors may have a better way to do this, but it is not likely.

3.3. Alternative 3 - Minimal System & Programming Impact

3.3.1. Overview

Remove the PIN part of Alternative 2 which is between {17} and {18}

3.3.2. Notes:

See the separate commentary on PINless security.

Appendix C

**Draft Commentary on Touch Tone™/Voice Response
System Security for Michigan Trains**

Quick Study on Michigan Train Permitting

Draft Commentary on Touch Tone™/Voice Response
System Security for Michigan Trains

David Moffett
Purdue University, School of Civil Engineering

One question that is sure to come up with respect to Purdue's TT/VR system specification for the issue of whether to add a PIN (personal identification number) or not. This document attempts to address the pros and cons of that issue.

Rick Good of Indiana Department of Revenue makes a good case against adding a PIN to the system. The essence of his arguments are two quite valid points.

1. The existing system does not have a means of securely identifying a caller.

2. As a result of [1.], there is no need to add a PIN to the system because it is based on top of a system that is less secure than what a PIN offers.

Purdue's position is that inherent to the existing system is some sanity checking. The permit clerk is the ultimate arbitrator of the validity of the caller. With TT/VR the state has lost two security assets.

One case comes to mind that will certainly happen sooner or later in a PINless system which brings this out.

If a company has a permit clerical that is terminated or quits under less than optimal conditions, what is to prevent that clerical from dialing the TT/VR system at 2 A.M. and racking up dozens if not hundreds of bogus permits? There will be no waiting to retard their actions nor will their be an state permit clerk to get an unpleasant feeling about the call and ask questions. Further, after such an event is detected, the only way to prevent more such calls is to issue the firm a new company number which seems lengthy and confusing.

With a PIN based system, when the clerical person departs, their supervisor can call the state and have the PIN changed. At that time the permit clerk can check extensively to assure themselves that the person changing the PIN has that right. The firms insurance carrier and a variety of dates which would not normally be used in the permit acquisition process are all supplemental pieces of information that can be used to validate that the supervisor is who they say they are. This is similar to the too often used

"mother's maiden name" that credit card companies have used for caller authentication for over thirty years.

Ever since the permitting process was understood by Purdue, a wide variety of security questions have been left unanswered. Introducing a PIN just assures that the introduction of TT/VR does not further weaken a system which should be viewed as already questionably secure.

Appendix D

**Draft Commentary on Touch Tone™/Voice Response
System Vendor for Michigan Trains**

Quick Study on Michigan Train Permitting

Draft Commentary on Touch Tone™/Voice Response
System Vendor for Michigan Trains

David Moffett
Purdue University,
School of Civil Engineering

Purdue is quite concerned about the relative merits of the two proposed system vendors for the hardware and core software of the Michigan Train TT/VR. It should be noted that neither Purdue, nor either of the researchers have any known monetary interest in either system or vendor.

Without regard for the arcane, lengthy and counter-productive procurement rules within the state, Purdue believes that expansion of the system already installed within the Indiana Department of Revenue is a substantially superior option.

Purdue's belief is based on the following areas:

1. IDR has substantial and presently available working knowledge of the IBM Direct-Talk II system. This knowledge will certainly allow for a quicker time to Michigan Train's TT/VR system being available for production use.

2. IDR has a "professional services" consultant for the IBM TT/VR system that is already up to speed with the way IDR operates its system. The consultant resides in the Indianapolis area and thus is readily available for both immediate problems and the likely possible enhancements of such a system.

3. The Ameritech system is under a 2+2 lease to the state. That means that two years after the system's first lease was signed, a renewal might be signed. At the end of four years then the system might be purchased by the state, might by re-leased or might be returned to the vendor. At present, the state is approximately eight months into the first of the two two-year periods.

This means that if the Ameritech system was selected, it is quite possible that in either 16 months or 40 months the system would be removed from service and the programming effort predominately lost that went into such a system.

The IBM system's proposal is for a purchase/expansion and thus has no limit on it's duration within Revenue. It not unreasonable to expect systems such as this to last at least five years.

4. The IBM system is already supported within IDR. The addition of a different system will require additional substantial recurring person hours to assure that software updates and external changes that occur to the IDR computer environment are reflected back into two different kinds of systems instead of just one. The recurring costs are difficult to estimate because the future if the IDR computer system is difficult to predict.

5. The IBM system's costs are sufficiently small that even if the system was retired at 5 years and the hardware scrapped the state would have received substantial value over and above what the system cost.

6. The degree of difficulty in dealing with Ameritech, then its subcontractors and then their vendors adds the unpleasant possibility of finger pointing between four or more different parties (IDR, Ameritech, the contract programming firm, the hardware vendor, IBM...). Finger pointing is a classic problem that happens in a heterogeneous environment where each party blames the other on something not working as it should. The IBM alternative is a single source responsibility as the vendor is a business partner with IBM.

As of this writing, Purdue has not received the Ameritech cost estimate. However, even if it was free (which it certainly will not be), the time-to-turn-on & support for the IBM system and uncertain availability and development of the Ameritech system would have Purdue select the IBM's system expansion.

Appendix E

Draft Commentary on Touch Tone™/Voice Response System Auditability for Michigan Trains

Quick Study on Michigan Train Permitting

**Draft Commentary on Touch Tone™/Voice Response
System Auditability for Michigan Trains**

**David Moffett
Purdue University, School of Civil Engineering**

Purdue (Bob Whitford and David Moffett) is concerned that the ability to audit any proposed Touch Tone™/Voice Response system is not being sufficiently considered. This note discusses the topic from a variety of directions and supports what we have required in our TT/VR specification. Obviously, since Purdue is acting as only consultants to this project, the state has the right to revise that proposed specification, but if it does, it goes against Purdue's better judgment.

1. Background

1.1. The current permitting system.

The existing operator based system is operators talking to users by voice or facsimile. In the case of voice, the entire conversation is tape recorded on two magnetic tapes. One of these tapes is used for immediate replay, if there is any confusion and the other is held as an archive of the interaction for as long as the Indiana records law requires. Facsimile transactions are on paper and thus are subject to substantially less opportunity for ambiguity. Permits issued by the various district offices are not recorded.

As a result, if a major crash occurs to the computer system and transactions already in the computer are lost, playing back the tape and re-entering the transactions allows the majority of the transactions to be recovered with the user being unaware there was even a problem. This also means that the billing that is generated off these transactions can go on un-encumbered.

1.2. The current TT/VR applications in IDR.

There are two applications in production in the Department of Revenue. One is the taxpayer refund line. It allows the user to know information about their tax refund. The other is information about personal property tax due. Both systems are INFORMATION ONLY systems. Though the logs all the calls, no revenue is lost if the transactions are totally lost due to computer failure.

2. What is proposed

The Michigan Train TT/VR application dispenses permit numbers in exchange for money. If a transaction is lost two problems appear. First, the state loses $42.50 in revenue. Second, if there is a question by law enforcement about the validity of a permit, the permit office will be unaware a permit was issued, because the transaction was lost. If this occurs, the user might be ticketed incorrectly and the state would then be exposed to a lengthy set of complaints and/or litigation about the permitting process.

Purdue believes that it is unacceptable to lose any transactions.

As a result, the specification calls for a supplementary record of all transactions to be held in the TT/VR system until after at least one backup has been made of the host computer on which the permitting system resides.   As such, these transactions can be recovered should the permitting system database be lost back to the previous backup from a hardware or software fault. This then assures that the state can recover all the revenue it is owed and there is no new exposure to problems beyond that already in the existing system.

The archive kept by the TT/VR system will also need to keep the permit number issued so that the database can be restored completely to its correct state previous to any host computer crash.

The other possible failure mode, namely the TT/VR system crashing does not substantially hurt the validity of the data, unless the truly weird happens and both the host and TT/VR systems crash simultaneously. Purdue views the probability of this happening as sufficiently small to not be worried about it.

In either case, a crash may result in transactions in process being left in an indeterminate state. The log file kept on the TT/VR system will help straighten out such problems.

If the internal auditors were interested, it would be a straight forward matter to check between the hosts database and the TT/VR log to assure that the same number of permits were issued by TT/VR means. This is in essence a double entry system and should be familiar to the auditors. Purdue believes that each of the TT/VR transactions should be at least attributable to TT/VR in the host database, and preferably even which line was used.   This will aid considerably in process of back tracking to find where particular transactions went astray should there be a problem.

3. Supplemental Check Digit

Supplemental or perhaps alternative to the logging of all transactions is the introduction of a numeric check digit to the permit number. The goal of this would be to determine, given a permit number, if it was valid. There is substantial previous use of such systems in two of the largest numbering systems in the world, namely the Universal

Product Code (UPC) and the International Standard Book Number (ISBN). In both cases, with just the number, one can determine if the number is a valid one.

The core to such a scheme is the computation, in some sophisticated way, of a check digit that is added to the front or back of the permit number. This would ease the state's problems of being given a number by law enforcement but being unsure if it was a valid number or one made up to avoid getting into trouble.

If Purdue were implementing this system, the introduction of logging and check digits would both be done. The computation of a check digit is a trivial addition which adds one further way to assure that back tracking is possible and the transaction logging can be done by either of the proposed TT/VR systems.